REMARKS/ARGUMENTS

Claims 2-11, 18, 19, and 21 have been canceled. Claims 22-33 have been added. Support for the new claims 24-32 can be found in the original claims 2-11. Applicants respectfully submit that the new claims provided herein are supported by the originally filed specification.

The Examiner has acknowledged that claims 18 and 19 are directed to allowable subject matter if written as independent claims (See office action dated 6/27/00 page 7). Thus, Claim 18 and 19 have been canceled and rewritten as newly added independent claim 33.

Claim 22 has been added in order to more particularly point out and distinctly claim that which Applicants deem to be the invention. New claim 22 replaces canceled claim 21 and is directed to the same subject matter as canceled claim 21. Applicants respectfully submit that the modifications to the claims provided herein are supported by the originally filed specification.

The rejection of claims 2-11, and 21 under 35 U.S.C. §103(a) as being unpatentable over Shimbo et al. (U.S. Patent No. 4,738,935) in view of Lee et al. (U.S. Patent No. 4,900,372) and Narayan et al. (U.S. Patent No. 5,208,182) is hereby traversed and reconsideration thereof is respectfully requested in view of Amendments to the claims contained herein and the following remarks.

Newly added Claim 22 specifically points out the novelty of the invention that depending on the epilayer selected for a certain device, in pertinent part,

(b) forming a composite substrate having a greater composite thermal expansion coefficient than the epilayer thermal expansion coefficient if a composite lattice constant of the substrate is smaller than the epilayer

lattice constant, or forming a composite substrate having a smaller composite thermal expansion coefficient than the epilayer thermal expansion coefficient if the composite lattice constant is greater than the epilayer lattice constant and

(c) disposing on the composite substrate a buffer layer having a buffer layer lattice constant substantially identical to the epilayer lattice constant, and

if the buffer layer lattice constant is greater than the composite lattice constant, then selecting the buffer layer wherein the buffer layer thermal expansion coefficient is greater than the composite thermal expansion coefficient, and

if the buffer layer lattice constant is smaller than the composite lattice constant, then selecting the buffer layer wherein the buffer layer thermal expansion coefficient is smaller than the composite thermal expansion coefficient; ...

The present invention teaches a method to utilize the relationship between lattice constant and thermal expansion coefficient to reduce stress during epilayer growth when the epilayer and composite substrate have mismatch lattice constants. With regard to Shimbo et al, various parameters such as thermal expansion coefficients and lattice mismatch are suggested to have effects on substrate bonding, however, Shimbo et al does not teach nor does it suggest the relationship among "the lattice constant and thermal expansion coefficient of the epilayer", "the lattice constant and thermal expansion coefficient of the composite substrate," and "the lattice constant and thermal expansion coefficient of the buffer layer."

Similarly, the relationship disclosed in elements (b) and (c) of applicant's invention is not found in Lee et al. Lee et al teaches a method to reduce stress during epilayer growth via usage of buffer layers. However, no criteria such as that listed in

element (c) of applicant's invention are disclosed. Examiner points out that Lee et al. discloses the need to optimize conditions depending on the material used (Final office action dated 8/23/01). However, the optimization suggested is for annealing conditions for the specific buffer used and is not optimizing the epilayer growth process. No criteria are specified in selecting the optimal buffer material for the epilayer growth process.

Narayan et al discloses a method of reducing stress by using a buffer layer system with the selection criteria of repeating of the superlattice buffer layer until the buffer layer is greater than the critical thickness for bending the dislocations. However, there is no mention of the relationship among "the lattice constant and thermal expansion coefficient of the epilayer," "the lattice constant and thermal expansion coefficient of the composite substrate," and "the lattice constant and thermal expansion coefficient of the buffer layer," which is disclosed in Applicant's application.

Since all three references do not disclose or suggest the utilization of the lattice constant and the thermal expansion constant relationship as taught by the present application to reduce stress during epilayer growth, the combination of the three references would not suggest to someone skilled in the art the usage of such novel relationship in reducing stress during epilayer growth.

In addition, the Examiner rejects claims 5-6, 9-11,as being unpatentable in view of the above references and further in view of Furuyama et al. Furuyama only discloses a semiconductor device that has InP with GaInAs deposited thereon (Final office action, page 5) and does not mentioned a method that utilizes the lattice constant and the thermal expansion constant relationship as taught by the present application to reduce stress during epilayer growth. A device with InP with GaInAs deposited thereon is not the invention that applicants are proposing, instead, applicants are proposing a method of

utilizing the lattice constant and the thermal expansion constant relationship as taught by the present application to reduce stress during epilayer growth.

Therefore, for the foregoing reasons, Applicants respectfully submit that the Examiner's rejection of claim under 35 U.S.C. §103(a) over Shimbo et al. in view of Lee et al., Narayan et al, and Furuyama et al. be withdrawn in view of presented background material

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned **"Version with markings to show changes made."**

In view of the above, it is respectfully submitted by Applicants that the claims are in condition for allowance. Reconsideration of the rejections is requested. Allowance of the claims at an early date is solicited. Formal drawings will be submitted by Applicants upon indication of allowed claims.

Respectfully submitted,

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"VERSION WITH MARKINGS TO SHOW CHANGES MADE"

In the Claims:

Please cancel claims 2-11, 18, 19, 21.

Kindly add new claims 22-33:

22. (New) A method for forming low defect density epitaxial layers on lattice-mismatched substrates, comprising:

d) selecting an epilayer having an epilayer lattice constant and an epilayer thermal expansion coefficient;

e) forming a composite substrate having a greater composite thermal expansion coefficient than the epilayer thermal expansion coefficient if a composite lattice constant of the substrate is smaller than the epilayer lattice constant, or forming a composite substrate having a smaller composite thermal expansion coefficient than the epilayer thermal expansion coefficient if the composite lattice constant is greater than the epilayer lattice constant,

f) disposing on the composite substrate a buffer layer having a buffer layer lattice constant substantially identical to the epilayer lattice constant, and

if the buffer layer lattice constant is greater than the composite lattice constant, then selecting the buffer layer wherein the buffer layer thermal expansion coefficient is greater than the composite thermal expansion coefficient, and

if the buffer layer lattice constant is smaller than the composite lattice constant, then selecting the buffer layer wherein the buffer layer thermal expansion coefficient is smaller than the composite thermal expansion coefficient; and

d) disposing the epilayer on the buffer layer.

23.(New) The method according to claim 22, wherein the substrate comprises one or more substrates.

24. (New) The method according to claim 22, wherein the disposing of the buffer layer comprises:

growing the buffer layer on the composite substrate;

thermally annealing the buffer layer and composite substrate when the buffer layer reaches a thickness of a bending radius of at least a majority of threading dislocations present in the buffer layer; and

repeating the growing and thermally annealing steps until an aggregate buffer layer thickness is greater than the bending radius of substantially all threading dislocations present in the buffer layer.

25. (New) The method according to claim 22,wherein the buffer layer is grown on a first substrate layer.

26. (New) The method according to claim 22, wherein the buffer layer is grown on a second substrate layer.

27. (New) The method according to claim 22, wherein the disposing step of a first epilayer on the buffer layer comprises growing the first epilayer on the buffer layer.

28. (New) The method according to claim 27, further comprising the step of growing a second epilayer on the first epilayer.

29. (New) The method according to claim 22, wherein the first substrate layer is of a material selected from a group consisting of GaP, Si, and Ge.

30. (New) The method according to claim 29,wherein the second substrate layer is of a material selected from a group consisting of InP, Ge, and Si.

31. (New) The method according to claim 30,wherein the buffer layer is of a material selected from a group consisting of AlGaAs, InAlAs, and InGaAs.

32. (New) The method according to claim 31, wherein the first epilayer is of a material selected from a group consisting of AlInGaP and InP.

33. (New) A method for forming low defect density epitaxial layers on lattice-mismatched substrates, comprising the steps of:

a. selecting an epitaxial layer having an epilayer lattice constant and an epilayer thermal expansion coefficient;

b. forming a composite substrate having a greater composite thermal expansion coefficient than the epilayer thermal expansion coefficient if a composite lattice constant of the substrate is smaller than the epilayer lattice constant, or forming a composite substrate having a lower composite thermal expansion coefficient than the epilayer thermal expansion coefficient if the composite lattice constant is greater than the epilayer lattice constant,

c. forming the composite substrate with a first substrate layer and a second substrate layer wherein a ratio of thickness of the first substrate layer to thickness of the second substrate layer is greater than one;

d. disposing on the composite substrate a buffer layer having a buffer layer lattice constant substantially identical to the epilayer lattice constant, and

if the buffer layer lattice constant is greater than the composite lattice constant, then selecting the buffer layer wherein the buffer layer thermal expansion coefficient is greater than the composite thermal expansion coefficient, and

if the buffer layer lattice constant is smaller than the composite lattice constant, then selecting the buffer layer wherein the buffer layer thermal expansion coefficient is smaller than the composite thermal expansion coefficient; and

e. disposing the epilayer on the buffer layer.